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Entry and Competition in the U.S. Brewpub Industry during 2002 - 2011

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Abstract: This study examines product differentiation and market structure in the U.S. brewpub industry. Brewery restaurants are characterized by whether they are single-establishment or multiple-establishment restaurants. In particular, I investigate how entry behaviors of firms are affected by the existence of opposite type of brewpub in a market. I use data from oligopoly brewpub markets across the United States during 2002 and 2011. The analysis uses a cross sectional data in a discrete dependent variable econometric model to predict the profitability of a market. The results indicate that the existence of one opposite type of firm in a market makes a market unattractive for a new firm, and these effects are diminished when there are two or three opposite of firms present in a market. Finally, the effects of demand characteristics, such as population size, can be large enough to outweigh the effects of differentiation between firms.

I. Introduction

The relationship between the market structure and market outcomes has been an abiding issue in industrial organization. Economists believe that prices tend to converge to the competitive level as the number of firms grows, although the rate of convergence depends on numerous factors such as the elasticity of demand. Due to the lack of information on prices, characteristics of product, and cost structures, it is difficult to separate the demand, strategic factors affecting the presence of firm in a market. As a result, establishing the number of firms necessary to ensure effective competition is a challenging problem.

Several studies, including Bresnahan and Reiss (1988, 1990) and Xiao and Orazem (2010), have developed econometric model addressing the relationship between market structure and the entry decisions of firms. Bresnahan and Reiss define profits by multiplying market size by profit variables then subtracting fixed cost, with each of these three elements defined as a reduced-form linear function. Several studies utilized a reduced form profit model to explain why firms prefer to enter some markets more then others. By using a reduced form profit model, this paper will examine whether differentiation among firms is helpful to explain brewery restaurant entrant behavior across the United States markets. In particular, I will analyze how entry behaviors of firms are affected by the existence of opposite type of brewpub in a market.

Brewery restaurants or the brewpub industry is an interesting subject to study because the industry has been expanding recently. This study investigates features of localized markets needed to support entry of brewery restaurants. Additionally, cities in the United States had experienced competitive brewpubs markets; brewpub restaurants

entered into competition with each other. This study provides important contributions to the literature by providing evidence of competition between different types of firms in markets.

My empirical analysis of entry model follows the framework of Mazzeo (2002) and Greenstein and Mazzeo (2006) closely. The model measures how homogeneous competitors compete against alternative competitors.

I compiled a data set from the list of brewery restaurants in the annual "Industry Review" from the magazine *The New Brewers* (The Brewers Association) from 2003 to 2012. The survey reports the name and location of brewpubs in the U.S. The data on characteristics of each market were drawn from 2000 and 2010 Population Census in Census County Subdivisions (CCSs) level. The measure of market size is the total population in CCSs. I also use age, ethnicity, education level, and median household income as factors that might affect local demand of brewpubs. In addition, I use annual mean wage for jobs involving food preparation from Bureau of Labor Statistics to control for the decision to open the brewpubs.

Besides providing evidence about the competition between different types of firms, this paper studies an interesting industry that has not been much investigated. The past research on the brewing industry has generally focused on the mass-production breweries (e.g. Tramblay and Bremblay, 2005). The microbreweries in the U.S. have diminished during the prohibition period. However, they have recently increased in number. Thus, the studies of entry and endogenous market structure would help us understand this rapid growth of the brewpub industry better.

II. Literature review

The study of the market structure of oligopoly and market outcome has been a longstanding issue in industrial organization due to the lack of important information on prices, firms' cost structures, and characteristics of product. Many economists try to predict the condition sufficient for a firm to enter a market.

Bresnahan and Reiss (1987, 1990, 1991) propose a link between models of endogenous market structure and models examining market competition. Since the information on price-cost margins is limited, they use cross sectional variation in the number of firms to link entry thresholds with changes in firms' competition. Ultimately, they determine the market sizes or total population in the market required to support different numbers of firms.

The breakeven market sizes or different numbers of population required to support one, two, or three firms provide information about how competition changes with entry of additional firms. In other words, the first entrant has monopoly power to charge a higher price; it can recover fixed entry and production costs with a relatively small number of units sold or customers served. As additional firms enter the market, these firms' power to set price may diminish relative to the first entrant. As prices fall, a larger market size or a larger number of customers served are needed to recover from the fixed costs. Hence, the entrant of the second firm requires a greater market size than the first entrant, and the entrant of the third firm requires an even larger market size than the second entrant, and so forth. Once there are three to five firms in a market, Bresnahan and Reiss (1991) find that the next entrant does not change the market competitive level much.

The variation in entry threshold reveals information about the changes in competition as additional firms enter a market. Manuszak (1999) follows Bresnahan and Reiss's framework of using a market entry model to determine entry condition and competition in the 19th century American brewing industry.

The advantage of such structure is that researchers can allow the number of competing firms to enter the variable profits function and the fixed cost function separately, and thus allow for different interpretation about the role of market structure. Economists can estimate an entry threshold or a measure of the market size required to support a given number of firms.

However, the structural model approach has some limitation as Bresnahan and Reiss point out in their paper. First, the methodology is best suited to geographically distinct local markets. So, the market boundaries have to be clearly defined. Mobile populations may be willing to drive a considerable distance to access some service providers such as health practitioners or auto dealers, making it difficult to pin down the exact number of firms operating in the local market. Second, the entry threshold ratios vary significantly across industries. Large differences in threshold ratios may suggest more variation in competitive conduct than actually exists.

Researchers do not make this distinction modeling profit by a single reduced form equation. This is explained in that variable profits do not necessarily increase in proportion to market size, and measures of variable profits and fixed costs usually are unavailable. For the same reasons, I decide to adopt a reduced form profit function.

In order to make inferences about the relationship between market competition and the number of operating firms, I need to consider factors that affect inherent features

of localized markets that affect firms' profitability. These factors include the costs of entering and operating, and the size of local market demand.

As of costs of entering and operating, we need to hypothesize that brewery restaurants required that their post-entry variable profits can cover their fixed cost of entry (Bresnahan and Reiss, (1991), Manuzak (2006)). Thus, the amount of fixed costs influences brewpub entry behavior. These fixed costs include engineering costs, marketing expenses, etc.

There are differences across cities in the costs of providing services including both fixed and operating costs. If a firm has multiple establishments, it could share fixed and operating costs such as marketing costs, administrative costs, etc. Additionally, the variation in population, restaurant activity, and other factors might contribute to the demand, hence profitability, for the brewery restaurants. Tremblay and Tremblay (2005) suggest that prices of beer, the prices of substitutes and complements, the consumer's income, the product's characteristics, and the consumer's level of consumption capital could influence the demand for beer as well.

Greenstein and Mazzeo (2006) conclude that the distinction between national and local telecommunication entry in service offerings affect entry behavior. They suggest that customers find the two types of firms to be imperfect substitutes. Similar to the brewpub industry, the brewery restaurants usually are costumed to customer needs because they are located close to their customers. Carroll and Swaminathan (2000) propose that some consumers prefer local products to items produced by large firms. Brewery restaurants target local costumers by sponsoring community event, providing

displays in local establishments, and distributing bar boasters. This might be the reason that local and national brewpubs would potentially differ in the minds of consumers.

By following the framework of Greenstein and Mazzeo (2006) closely, I will examine the effects of differentiation between firm-type, specifically single and multiple establishment firms, on entry behavior.

III. Data

In order to determine entry thresholds for brewpub, we need to define the local market. Since brewpubs sell more than 50 percent of their craft-style beer on site, brewpubs intend to serve local customers. In normal circumstances, consumers go to brewpubs close to their neighborhoods. Still, consumers' demand has some mobility because customers can travel from one market to another. To simplify the problem, I assume that the consumer's demand has zero mobility. Thus, definition of market is defined.

The primary data set used in this study is compiled from:

1. Cross-sectional information about the presence of brewery restaurant. The New Brewers Magazine reports firms operating in cities across the United States. The survey includes the identities of the firms, locations, and their production level [2003, 2012].
2. Cross-sectional information about the demographic for breweries restaurants in county subdivision level. The demographics and other economic conditions come from 2000 and 2010 U.S. Census.

The data set is not an ideal one due to a few major restrictions for several reasons. First, brewery restaurants are not required to report their presence to the Craft Beer Association. Secondly, even though the survey has an important variable of interest - location, it neither provides a total number of brewpubs in a city level nor a clear definition of markets other than state.

To complement the main data, I find the brewpubs' locations in a county subdivision level. Then, I count the number of brewpubs categorized by the cities that they are located in, and merge information from the 2000 and 2010 Population Census based on Census County Subdivision (CCSs).

The measurement of market size is the population in CCSs. I also use age, ethnicity, education level, and median household income as factors that might affect local demand of brewpubs. Additionally, I use annual mean wage for jobs involving food chief and food preparation from Bureau of Labor Statistics to control for the decision to open the brewpubs.

Sample selection and summary statistics

By using a data on cross-section of markets, I attempt to examine competition among brewery restaurants. To do so, I need to differentiate firms into firms with single establishment and firms with multiple establishments. Additionally, I need to carefully define markets in a way that only firms in the market compete with each other and that no firms outside the defined market are competitors.

The market definition is at the level of county subdivision level. The breweries restaurant provide inherently locally focused – the firm must establish a presence in a city in order to connect customers residing there. This makes most small and medium-sized

cities geographically distinct market area. I also include larger cities and Metropolitan Statistical Areas (MSAs) in the analysis.

I construct a sample of every city in the United States with at least one brewpub in either 2002, 2005, 2008, or 2011. There are total of 947 observations in the sample. The Table I shows the firm counts from 2002 to 2011. The number in each cell indicates the number of cities that have corresponding number of operating brewery restaurants. Roughly 27 to 35 percent of the sample does not have a brewpub when the survey occurs. A total of 49 to 55 percent of the cases had only one firm operating. The numbers of cities with no brewpub are getting smaller as more firms operate.

Table I: Number of Operating Brewery Restaurants in the Market

	Year			
Operating	*2002*	*2005*	*2008*	*2011*
0	334	305	302	258
1	446	476	503	519
2	92	100	84	114
3+	75	66	58	56
Total	947	947	947	947

To study the differentiation among brewpubs, I classify firms into discrete categories on the basis of how they vary in the geographic extent of their operations. As was previously discussed, product characteristics associated with a brewpub's geographic footprint may attract different types of customers. I classify brewery restaurants to be

single establishment if they operate in one location. If firms that have two or more restaurants operating within a few cities or in multiple regions of the country, they are labeled *multi* establishment.

Table II contains the breakdown between the single and the multi establishment brewpubs across the individual markets in the data set. Part A of the table summarizes the firm counts in 2002 with the number of cities that have corresponding number of operating *single* establishment and *multi* establishment.

Similarly to Part A, Part B of Table II specifies similar data for 2011. The number of cities with no operating brewpubs had reduced to 258. Note that the cities with fewer operating brewery restaurant typically contain predominately *single* establishment firms.

Table II: Number of Multiple and Single establishment brewpubs per City

A. 2002 Data

	Multiple establishment Brewpubs				
Single establishment Brewpub	*0*	*1*	*2*	*3+*	*Total*
0	334	78	12	1	425
1	368	31	8	6	413
2	49	8	7	3	67
3+	16	14	8	4	42
Total	767	131	35	14	947

B. 2011 Data

	Multiple establishment Brewpubs				
Single establishment Brewpub	*0*	*1*	*2*	*3+*	*Total*
0	258	96	12	1	367
1	423	37	3	7	470
2	66	9	5	3	83
3+	14	6	3	4	27
Total	761	148	23	15	947

To study differentiation among brewery restaurants, we need to account for the differences of localized features of the cities that attract brewpubs. To control the effects for these differences, I collected demographic data for each city in the sample. The data is gathered from 2000 and 2010 U.S. Censuses in county subdivision level. The data in county level is used instead when information at the county subdivision is unavailable.

Market size is a very important variable. Brewery restaurants intend to service resident population. Thus, the number of town population reflects firms' profitability. *Population* measures each city's town population, *PHouseholds* corresponds to the percentage of households maintained by families in each city, and *Median Household Income* denotes the average income of the city's residents.

Some variables characterize the composition of each city. *PMale* describes the percentage of the population who were male. *PHighSchool* denote the percentage of

population that obtain high school education or higher. *PGerman* and *PIrish* denote the percentage of population that has German and Irish ancestry, respectively.

The variable *Median Wage Food Prep* denotes the average wage for jobs involving food cooking and food preparation. *Area* represents land area in square miles for each city in the sample. Note that the annual data for demographics is not available at the level of individual cities. And, the year-on-year changes in these variables should not be large enough to considerably affect entry decisions.

Table III describes demographic variables mentioned above. Data in part A are from Census 2000, and data in part B are from Census 2010. In part A, on average, markets have a population of 109,160 with a land area of 67.645 square miles. Roughly 49 % are male. Median income average $44 thousand with 84.5% of population having had at least high school education.

For the data from Census 2010, on average, markets have a population of 113,483. Male population was decreased to 42.7 %. Median income average $54 thousand with 88.3% of population having had at least high school education. Note that the information on ancestry's race was available in Census 2000 only. On average, markets have 12.9% German, and 19.8% Irish.

IV. Empirical Models of Brewpubs Entry

This paper utilizes a reduced form profit function to evaluate the behavior of firms' decisions to enter the brewery restaurants industry. The baseline model focuses on a key difference between single establishment firms and multiple establishment firms observed in particular years of a growing market.

Table III: Explanatory Variables – Summary Statistics

Variable	*A. 2000*		*B. 2010*	
	Mean	*Standard Variable*	*Mean*	*Standard Variable*
Population (in million)	0.1091602	0.274	0.1134833	0.272
PHouseholds	0.647	0.095	0.633	0.098
Area (in ten thousand)	0.0067654	0.044	0.0067654	0.044
PHighSchool	0.845	0.073	0.883	0.065
Median Household Income (in ten thousand)	0.0443075	0.015	0.0544056	0.020
Median Age	36.027	5.405	38.135	6.719
PMale	0.491	0.022	0.427	0.019
PGerman	0.129	0.050	0.129	0.050
PIrish	0.198	0.112	0.198	0.112
Median Wage Food Prep (in thousand)	1.829379	0.051	1.829379	0.051

Econometrician infers the economic factors that contribute to the equilibrium of the observed market structure by using a cross-section of markets as a data. Firms either choose to enter or not enter a particular market. The estimation can be complicated because the decision of competing firms influences the expected profitability of potential alternatives.

(i) Entry Model

In general, the profits and costs in brewery restaurants cannot be observed. However, many previous empirical papers on market entry have estimated the underlying profitability of a market by inferring from the number of firms in a market to characteristics of market. These studies use the number of firms as a dependent variable. Assuming that the variation in market structures is iid normal across markets, one can use an ordered probit model to estimate a reduced form profit function.

A reduced form profit function might look like:

$$\pi_m(N_m, y_m, w_m) = y_m \alpha + N_m \beta + w_m \gamma + \varepsilon_m ,$$

where m denotes an isolated market. Markets might have different characteristics w_m that affect demand for the firms' products or firms' market specific costs. The term N_m denotes the number of firms that have entered the market. Its coefficient, β, indicates the extent to which additional market participants make entry less attractive. The term ε_m denotes variation in market structures or the components of firm profits that are unobservable by economists.

Assume that the number of firms in the market (N_m) reflects the outcome of competition between the firms in market m. Then, this assumption implies that the number of operating firms in a market is in equilibrium. In other word, markets are containing the maximum number of firms such that the market m is profitable for each of those firms to enter given conditions in that market. In particular, the equilibrium number of firms in market m is defined by:

$$N_m^* = 0 \qquad \text{if } \pi_m^1 + \varepsilon_m < 0$$

$$N_m^* = N \qquad \text{if } \pi_m^N + \varepsilon_m \geq 0 \text{ and } \pi_m^{N+1} + \varepsilon_m < 0$$

where $\pi_m^N = \pi(N_m = N, y_m, w_m)$.

Assume further that the random term ε_k is iid normal across markets, the probabilities of observing N firms in market *m* are:

$$P(N_m^* = 0) = 1 - \Phi(\pi_m^1)$$

$$P(N_m^* = 1) = \Phi(\pi_m^1) - \Phi(\pi_m^2)$$

$$P(N_m^* = 2) = \Phi(\pi_m^2) - \Phi(\pi_m^3)$$

$$P(N_m^* \geq 3) = \Phi(\pi_m^3)$$

where $\Phi(\,)$ is the cdf of a standard normal random variable with the variance of the disturbance term normalized to one. Note that this assumption allows me to use the ordered probit model to estimate the parameters.

(ii) Extensions to Heterogeneous Markets

By following the Greenstein and Mazzeo's framework, I can extend the approach *(i)* to analyze firms in heterogeneous markets. Suppose that each market could have firms of two types, X and Y. Suppose that at the equilibrium, there are N_X and N_Y observed firms for firms type X and firms type Y, respectively. Similarly to (1), a reduced form of type-specific profit function might look like:

$$\pi_{Tm}(N_{-Tm}, y_m, w_m) = y_m \alpha \;\; + \; N_{-Tm}\beta_{-T} + \; w_m \gamma \;\; + \; \varepsilon_m \;\; ,$$

where N_{-Tm} denotes the number of firms of the other type, and the term π_{Tm} denotes expected profit of firm in which characterized by the number of same-type firms in the market. This model allows me to look at the effects of competitors to vary on the basis of whether they offer the same or different product types.

A market observed with two types X and Y implies that the following equalities hold:

$\pi_X\,(X,Y) > 0\,,$ $\qquad$ $\pi_X\,(X+1,Y) < 0$

$\pi_Y\,(X,Y) > 0\,,$ $\qquad$ $\pi_Y\,(X,Y+1) < 0$

$\pi_x\,(X,Y) > \pi_Y\,(X-1,Y+1) > 0\,,$ $\qquad$ $\pi_Y\,(X,Y) > \pi_X\,(X+1,Y-1) > 0$

In case of brewery restaurant, I assume that there are two possible types of brewpub firms – firms with *single* establishment and firms with *multiple* establishments. Entry decisions made by firms are based on market-by-market basis.

Greenstein and Mazzeo (2006) clarify in their paper that the potential entrants were playing a Stackelberg game in this model. The most profitable type firms will move first. The outcome of the market is arrived when no more potential entrants want to enter the market at each stage. With assumption that firm within the same type are identical, entry is determined at each stage by comparing whether the next local firm is more or less profitable than the next national firm, assuming that potential entrants are making optimal decisions.

(iii) Identification and Testing

Identification of the parameters representing competitive effects comes from comparing otherwise similar markets with different structures or, conversely, different markets with otherwise similar structures. The estimated β and γ- parameters help to make market more similar as they account for exogenous characteristics and that make entry of brewery restaurants industry more attractive. Controlling for market characteristics allows us to identify the β-parameters describing competition and make

inferences beyond what one could infer from comparisons with random assignment in the raw data.

IV. Empirical Results

The model of differentiated entry used in this study allow for up to three firms of each product type in the market. Thus, the endogenous market structure variable can take on one of nine possible outcomes. The maximum likelihood estimates of the expected profit functions from the differentiated entry model are in Table IV. Note the coefficient is estimated by order probit model; thus, the sign of the coefficients is interpretable but the magnitude of the coefficients is not. Additionally, positive and negative profits should be interpreted loosely due to the nature of ordered probit model. For each firm type and market configuration, a set of dummy variables is defined, and the corresponding β–parameters represent the incremental effects of additional competitors on the profits of firms in the market:

β_{S1} = effect of first multiple est. competitor on single est. brewpubs,

β_{S2} = effect of second multiple est. competitor on single est. brewpubs,

β_{S3} = effect of third multiple est. competitor on single est. brewpubs,

β_{M1} = effect of first single est. competitor on multiple est. brewpubs,

β_{M2} = effect of second single est. competitor on multiple est. brewpubs, and

β_{M3} = effect of third single est. competitor on multiple est. brewpubs.

Table IV : Heterogeneous Products Model

	2002		*2005*		*2008*		*2011*	
	Coeff.	*S.E.*	*Coeff.*	*S.E.*	*Coeff.*	*S.E.*	*Coeff.*	*S.E.*
Effect on Single Establishment Brewery Restaurants								
Population	1.5398	0.3698	0.9909	0.3079	0.8396	0.2760	0.7077	0.2876
PHouseholds	-2.9959	0.5954	-3.2496	0.5679	-2.8695	0.6088	-3.0019	0.5566
Area	-1.4015	0.9069	-1.5815	1.0353	-1.3350	0.8285	0.0451	0.5470
Multi Est. Competitor #1	-0.3890	0.1416	-0.6342	0.1327	-0.7199	0.1119	-0.7480	0.1328
Multi Est. Competitor #2	-0.0620	0.2597	-0.1445	0.2764	0.0271	0.2979	-0.1127	0.3298
Multi Est. Competitor #3	-0.0763	0.3916	0.2034	0.5087	0.3560	0.3553	0.2388	0.4165
PHighSchool	0.7925	0.7979	0.8679	0.7968	1.7456	0.8524	1.6472	0.8049
Median Household Income	9.4636	11.843	23.824	13.593	8.6411	9.8206	17.442	9.9189
Median Household Income square	-58.872	88.917	-172.29	112.85	-50.48	62.892	-120.55	65.673
Median Age	0.1154	0.0629	0.1481	0.0651	0.1707	0.0439	0.04890	0.0412
Median Age square	-0.0017	0.0009	-0.0021	0.0009	-0.0023	0.0006	-0.0006	0.0005
PMale	0.9322	1.7861	0.3473	1.8933	5.3491	1.8976	7.1512	1.6608
PGerman	-0.4915	0.3546	-0.1640	0.3396	-1.2011	0.9130	-2.2814	0.9163
PIrish	-0.4232	0.8804	-2.5404	0.9172	-0.6784	0.3527	-0.2452	0.3630
Median Wage Food Prep	1.0372	0.7799	1.1730	0.7620	1.6946	0.7924	2.1301	0.7984
/cut1 (Constant)	3.1031	2.1222	3.6927	2.0705	7.3935	2.0326	7.6967	1.9976
/cut2	4.5982	2.1202	5.1490	2.0690	9.9737	2.0345	9.3276	2.0018
/cut3	5.2262	2.1180	5.9216	2.0705	10.719	2.0365	10.134	2.0075

	2002		*2005*		*2008*		*2011*	
	Coeff.	*S.E.*	*Coeff.*	*S.E.*	*Coeff.*	*S.E.*	*Coeff.*	*S.E.*
<u>Effect on Multiple Establishments Brewery Restaurants</u>								
Population	1.3005	0.3135	1.3833	0.4189	1.5757	0.3378	1.3827	0.3279
PHouseholds	-3.1614	0.6317	-3.4505	0.7037	-3.2997	0.7286	-0.5776	0.6796
Area	-4.0577	5.2462	-3.6488	3.6448	-2.1355	2.3854	-0.7150	0.1101
Single Est. Competitor #1	-0.5130	0.1110	-0.7781	0.1121	-0.9128	0.1393	-0.4170	0.2075
Single Est. Competitor #2	-0.1551	0.2045	-0.2398	0.1783	-0.3593	0.2155	-0.1905	0.3025
Single Est. Competitor #3	0.1867	0.2299	0.0433	0.3456	-0.1583	0.3274	-2.6527	0.7431
PHighSchool	1.3504	1.1308	1.2591	1.1313	1.0384	1.2248	2.2226	1.3047
Median Household Income	40.817	15.829	40.274	15.357	24.6924	12.570	20.025	11.953
Median Household Income square	-178.23	122.63	-188.64	117.10	-77.784	80.309	-50.824	72.4268
Median Age	0.2502	0.1002	0.2715	0.0947	0.2959	0.0832	0.3045	0.0803
Median Age square	-0.0037	0.0014	-0.0037	0.0013	-0.0041	0.0011	-0.0044	0.0011
PMale	-8.1115	2.2294	-7.7670	2.2503	-4.146	2.2233	-3.6406	2.3277
PGerman	-1.6501	0.5465	-0.4593	0.4705	0.9198	0.4477	0.8916	0.4497
PIrish	-3.0681	1.2976	-3.7634	1.2513	-0.8288	1.1298	-1.5210	1.1770
Median Wage Food Prep	-0.9980	1.1124	-0.2900	0.9956	1.4267	0.9887	1.8535	1.0910
Constant	-0.9344	2.9346	0.8583	2.8236	7.3760	2.8978	8.5766	2.9298
Constant	0.0491	2.9306	1.9344	2.8182	7.5932	2.8985	9.7183	2.9388
Constant	0.8322	2.9291	2.7267	2.8324	8.0045	2.9161	10.261	2.9340

Column 1 – 4 corresponds to the market outcomes of the observations in 2002, 2005, 2008, and 2011, respectively. The upper section of the table presents the effect of *multiple* establishment competitors on *single* establishment brewery restaurants. The lower section of the table presents the effect of *single* establishment competitors on

multiple establishment brewery restaurants. The sign of coefficient indicate the attractiveness of entry for each type; if the constant is greater than zero, it indicates a firm would be more likely to enter.

For example, consider the population variable in 2011– the parameter estimate for both firm types is positive, which indicates that larger cities attract more brewery restaurants of either type. However, the estimated parameter is higher for the multiple establishment type of restaurant. This indicates that, as the population in a city increases, the relative attractiveness of entry for multiple establishment restaurants increases as well.

The relative value of the constants indicates that in a market with similar values for *X* variables and with no competing firms, operating a single establishment is on average more profitable than operating a multi establishment brewpub from 2002 to 2008. However, it is more profitable to operate a multiple establishment than a single establishment brewpub in 2011 ($C_{multi} = 8.5766 > C_{single} = 7.6967$)

The demographic composition of a market has a significant impact on the profitability of breweries. Single establishment firms prefer to enter a market where high *PHighSchool*, *PMale,* and *Median Wage Food Prep* as the coefficients are all positive. On the other hand, the multiple establishment firms prefer to enter a market with a high percentage of people with high school education or higher (*PHighSchool)* and lower percentage of male population *(PMale)*. The percentage of households that are family generally has a negative effect on profitability of both types of firms. The variables *Median Household Income* and *Median Age* demonstrate non-linear relationship between these variables and profitability. The compositions of German and Irish (*PGerman* and

PIrish, respectively) have negative impact on profit even though they are statistically insignificant.

The parameter estimates the impact of existence of the first firm that are opposite type on profitability, β_{S1} and β_{M1}, are negative. The parameter estimates the impact of opposite type of firm on profitability is bigger as there are more firms in a market. This indicates the competition in markets is less tough with more firms.

It is important to note that the key result in Table IV comes from the β–parameters which estimate competitive effects on the types of firms. The estimates indicate how the two types of firms compete against each another.

From the top part of Table IV, the existence of the first multiple establishment firm competitor makes entry unattractive. The β–parameters for existence of two multiple establishment competitors diminish to nearly zero throughout 2002 – 2011. Additionally, the additional multiple establishment firms have smaller affects than the first for both two ($\beta_{M1} = -.3890 < \beta_{M2} = -0.062$) and three multiple establishment firms ($\beta_{M1} = -0.3890 < \beta_{M2} = -0.0763$), the β-parameters above are observed from 2002. The similar effects can be observed from the effect of single establishment competitor on multiple-establishment brewery restaurants.

While the estimated β–parameters indicate incentives for firms to offer differentiated product, the demand effects are large enough to predict undifferentiated product-type configuration in some cases. For example, in 2008, population has a positive and significant effect on payoffs of both product types, 0.8396 for single establishment firm and 1.5757 for multiple establishments. The relative size of coefficients indicates that firms in markets with population above the sample mean tend

to choose the multiple-establishment type of firm, while single-establishment firms are more attractive in below-average population markets. Consider once again the product choice that would like to enter a market with one competitor. Let other *X* variables be at their sample mean, except *Population* is triple its sample mean at this market. In this case,

$$\pi_{single} = 7.3935 + (-0.7199) + (0.8396)*(3)*(0.113) = 6.9582,$$
$$\pi_{multi} = 7.3760 + (-0.9128) + (1.5757)*(3)*(0.113) = 6.9974 .$$

This empirical finding shows that this firm will earn relatively more by operating a chain brewpub.

V. Conclusion

This study empirically investigates the oligopoly market structure implications of endogenous product choice by firms. I characterize brewery restaurants into two types: single-establishment or multiple-establishment restaurants. This paper examines the competition between independent brewpubs and chain brewery restaurants.

The main conclusions follow from the estimated parameters of the model. First, the empirical evidence from oligopoly brewpubs industry show that the existence of one opposite type of firm in a market raise fixed costs, hence, makes a market unattractive. Successful brewery restaurants were mindful about the characteristics of their competitors.

Second, the effects of the presence of two or three opposite-type competitors on profitability are smaller than the effects of the existence of one opposite-type competitor. In some case, the presence of three opposite-type competitors encourages a new firm to enter the market. This can be explained by an incentive that a market with some number

of firms might signal a new firm that there are special characteristics of that market that yield positive profit.

Finally, the results demonstrate that demographic variables representing the influence of demand factors help predict both how many firms can operate profitably in a market and firms' product-type decisions. The effects of demand characteristics can be large enough in some cases to outweigh the relative difference in the competitive effects. As a result, it is indifference for a firm to operate as an independent brewpub or a chain brewpub.

The results might have nontrivial flaws due to several reasons. First, I lump the number of firms in a market into three when there are more than three firms in a market. Second, I did not include variables that represent the presence of same-type-firm in the model. As a result, I cannot observe how the existence of firms in the same type affects an entrant of a new firm.

Extension of the techniques that this paper employs could also serve to expand knowledge about the evolution of industries such as the brewing industry. In particular, an explicitly dynamic model along with panel data on the entry and exit decisions of firms as well as entry threshold could provide additional insight into this industry.

I. Appendix

Table V : Ordered Probits of Total Firm Counts

	2002		*2011*	
	Coeff.	*S.E.*	*Coeff.*	*S.E.*
Constant	0.7337	2.0434	7.5435	1.9491
Population	2.5315	0.7467	1.4444	0.5017
PHouseholds	-3.8453	0.5599	-2.9802	0.5558
Area	-1.9057	1.1892	0.0116	0.6091
PHighSchool	0.9241	0.7871	2.1349	0.8145
Median Household Income	20.712	10.921	16.432	8.8380
Median Household Income squared	-84.3678	75.840	-79.178	53.239
Median Age	0.1320	0.0600	0.0635	0.0411
Median Age squared	-0.0018	0.0008	-0.0009	0.0005
PMale	-0.7634	1.8487	5.7915	1.6762
PGerman	-0.8914	0.3830	0.0310	0.3773
PIrish	-0.9362	0.9158	-2.2344	0.9566
Median Wage Food Prep	0.1813	0.7627	2.0999	0.7768
Number of Observations	*947*		*947*	

Table VI : Heterogeneous Products Model with Four Opposite-Type Firms

	2002		*2005*		*2008*		*2011*	
	Coeff.	*S.E.*	*Coeff.*	*S.E.*	*Coeff.*	*S.E.*	*Coeff.*	*S.E.*
Effect on Single Establishment Brewery Restaurants								
Constant	3.0019	2.1008	3.6631	2.0653	8.2581	2.0316	7.5590	1.9794
Population	1.5285	0.3670	0.9646	0.2923	0.8168	0.2822	0.7347	0.2999
PHouseholds	-3.1108	0.6001	-3.2320	0.5600	-2.8981	0.6108	-2.9875	0.5657
Area	-1.2582	0.9062	-1.4358	1.0128	-1.3163	0.8324	0.0380	0.5359
Multi Est. Competitor #1	-0.3863	0.1406	-0.6352	0.1301	-0.8994	0.1386	-0.7459	0.1328
Multi Est. Competitor #2	-0.0344	0.2578	-0.1034	0.2783	0.0248	0.2912	-0.1137	0.3293
Multi Est. Competitor #3	-0.2796	0.3947	0.2400	0.8503	0.0895	0.3568	-0.0203	0.4131
Multi Est. Competitor #4	0.3409	0.6771	0.1326	0.5540	0.7104	0.6006	0.3308	0.6034
PHighSchool	0.7228	0.7939	0.8416	0.7976	1.7556	0.8521	1.6050	0.8032
Median Household Income	11.095	11.859	23.349	13.560	9.2149	9.8865	17.713	9.9233
Median Household Income squared	-67.595	89.060	-169.23	112.73	-55.128	63.506	-122.06	65.638
Median Age	0.1172	0.0628	0.1485	0.0650	0.1714	0.0437	0.0472	0.0410
Median Age squared	-0.0016	0.0008	-0.0020	0.0009	-0.0022	0.0005	-0.0006	0.0005
PMale	1.0740	1.8081	0.3773	1.8714	5.3444	1.8832	7.1906	1.6589
PGerman	-0.5085	0.3531	-0.1613	0.3378	-0.6826	0.3525	-0.2228	0.3614
PIrish	-0.4632	0.8803	-2.4689	0.9128	-1.2154	0.9093	-2.2329	0.9167
Median Wage Food Prep	0.9676	0.7706	1.1566	0.7593	1.6114	0.7911	2.0657	0.7845
Effect on Multiple Establishments Brewery Restaurants								
Constant	-0.7756	2.9155	0.7984	2.8307	6.4215	2.9194	8.8170	2.9547
Population	1.3265	0.3197	1.3318	0.3685	1.5180	0.2905	1.4224	0.3333
PHouseholds	-4.4939	5.2417	-3.4643	0.7103	-3.2896	0.7303	-2.7536	0.7549
Area	-3.1595	0.6287	-3.3033	3.5060	-1.9682	1.8384	-0.6239	0.6920
Single Est. Competitor #1	-0.5138	0.1105	-0.7812	0.1127	-0.7327	0.1117	-0.7169	0.1099
Single Est. Competitor #2	-0.1669	0.2033	-0.2382	0.1758	-0.3470	0.2119	-0.4336	0.2094
Single Est. Competitor #3	0.2286	0.2908	0.0455	0.3975	-0.0991	0.3422	0.3041	0.3788
Single Est. Competitor #4	0.1960	0.3094	0.1231	0.4458	0.0342	0.5231	-0.4658	0.4071
PHighSchool	1.4075	1.1227	1.2176	1.1456	0.9091	1.2347	2.2292	1.3245
Median Household Income	40.622	15.845	40.816	15.252	25.297	12.534	20.444	11.945
Median Household Income squared	-177.28	122.56	-191.21	116.44	-80.233	79.995	-51.802	72.285
Median Age	0.2508	0.1004	0.2709	0.0949	0.2948	0.0834	0.3067	0.0805
Median Age squared	-0.0036	0.0014	-0.0037	0.0013	-0.0041	0.0011	-0.0044	0.0011
PMale	-8.0216	2.2045	-7.662	2.2479	-4.0568	2.2400	-3.4955	2.3647
PGerman	-1.6477	0.5476	-3.8118	1.2475	0.9241	0.4459	0.9107	0.4502
PIrish	-3.0727	1.289	-0.4725	0.4682	-0.8358	1.1224	-1.5959	1.1859
Median Wage Food Prep	-0.9668	1.0697	-0.3260	0.9997	1.4856	0.9942	1.9397	1.1163

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